DELIVERABLE 4.2. REPORT ON THE PROCESS AND IMPACT EVALUATION OF THE INTERVENTION

VERSION V.2

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

VERSION CONTROL SHEET

- **Project summary**

Project acronym	SEEDS
Grant Agreement	101006251
Call	H2020-SwafS-2018-2020 (Science With And For Society)
Topic	SwafS-31-2020
Type of action	RIA (Research and Innovation Action)
Start date	01/01/2021
Duration	24 months
Coordinator	Fundació Institut d'Investigació Sanitària Pere Virgili (IISPV)

- **Document control**

Deliverable	4.2 Report on the process and impact evaluation of the intervention
Work Package related	WP4
Due date	December 2022
Delivery date	21st December 2022
Dissemination level	Public
Lead partner for deliverable	EMC
Authors	Annemieke Wargers, Famke Mölenberg, Wilma Jansen
Reviewers	All
Approved by	All
Version	2

- **Document revision history**

Revision	Issue date	Author	Comments
V0	October 2022	EMC: A. Wargers, F.J.M. Mölenberg, W. Jansen	Create lay-out of content deliverable
V0	November 2022	UOE: D. Vlachopoulos, C. Elphick, A. Senequier	Input on process and impact evaluation
V0	November 2022	HUA: N. Mourouti, Y. Manios	Input on impact and effect evaluation
V1	08-12-2022	EMC: A. Wargers, F.J.M. Mölenberg, W. Jansen	Create first draft with input from UOE and HUA
V1	12-12-2022	IISPV: J. Queral, E. Llauradó, L. Tarro	Revision
V1	12-12-2022	HUA: N. Mourouti, Y. Manios	Revision
V1	9-12-2022	UOE: D. Vlachopoulos, C. Elphick, A. Senequier	Revision

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

V1	14-12-2022	All, during consortium meeting	Agreements on final feedback comments
V2	20-12-2022	EMC: A. Wargers, F.J.M. Mölenberg, W. Jansen	Final version

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

TABLE OF CONTENTS

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

DISCLAIMER

This publication is the sole responsibility of SEEDS Consortium and reflects only the authors' view. Thus, the European Commission (EC) is not responsible for any use that may be made of the information it contains.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

ABBREVIATIONS

CoR	Gemeente Rotterdam
EC	European Commission
ECSA	Verein Der Europaeischen Burgerwissenschaften - ECSA E.V.
EU	European Union
EMC	Erasmus Universitair Medisch Centrum Rotterdam
FG	Focus group
GR	Greece
HBSC	Health Behaviour of School-aged Children
HUA	Charokopeio Panepistimio
IISPV	Fundació Institut d'Investigació Sanitària Pere Virgili
NL	The Netherlands
NS	Non-significant
PA	Physical activity
PE	Physical education
SEEDS	Science Engagement to Empower aDolescentS
SP	Spain
STEM	Science, Technology, Engineering and Mathematics
SWAFS	Science With And For Society
UK	United Kingdom
UOE	University of Exeter

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

LIST OF TABLES

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

LIST OF FIGURES

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

EXECUTIVE SUMMARY

Science Engagement to Empower aDolescentS (SEEDS) is a 2-year Citizen Science project that aims to engage and actively involve adolescents in generating new knowledge on interventions to promote healthy and active living. The objective of the SEEDS project is two-fold. On the one hand, we aim to increase healthy lifestyle of adolescents living in low socioeconomic areas. On the other hand, we aim to increase Science, Technology, Engineering and Mathematics (STEM) interest of adolescents.

In this deliverable we focus on the effect, impact and process evaluation of the SEEDS project and interventions. Impact evaluation was based on questionnaires completed by the students before and after the intervention. The process evaluation was based on student evaluation questions during the Makeathon, a questionnaire completed by the students after the intervention and input from students and stakeholders during the Brussels exchange in October 2022.

Regarding effect evaluation of the SEEDS interventions, no significant changes were found on PA (days/week), fruit consumption and STEM. However, preliminary findings showed that adolescents from intervention schools significant increased vegetable consumption compared to adolescents from control schools.

For the process and impact of the SEEDS project, several topics have been evaluated. Difficulties, opportunities and suggestions regarding reach, co-creation and interventions have been addressed by adolescents and stakeholders in Makeathon and intervention evaluation questions and during the Brussels exchange.

Overall, the SEEDS project has created impact on various fields and will continue to do so by exploiting the SEEDS approach, findings and recommendations in the future.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

1. INTRODUCTION

1.1. The SEEDS project

The SEEDS project is a 2-year Citizen Science project that aims to engage and actively involve adolescents in generating new knowledge on interventions to promote healthy and active living. Researchers collaborate with high school students from low socioeconomic areas in four countries throughout the research project. Students and stakeholders participate in focus groups, co-creation events, development and implementation of the interventions. Researchers empower and support adolescents in creating change to promote a healthy lifestyle, mainly focusing on physical activity and healthy nutrition.

The objective of the SEEDS project is two-fold. On the one hand, we aim to increase healthy lifestyle of adolescents living in low socioeconomic areas. On the other hand, we aim to increase Science, Technology, Engineering and Mathematics (STEM) interest of adolescents.

1.1.1. Consortium

The SEEDS Consortium is a multidisciplinary partnership built from two health research institution located in Spain (Institute of Health Research Pere Virgili, Reus) and The Netherlands (Erasmus Medical Center, Rotterdam), two universities from The United Kingdom (University of Exeter, Exeter) and Greece (Harokopio University, Athens), one local municipality from The Netherlands (City of Rotterdam, Rotterdam), and the international Civil Society organisation working specifically in Citizen Science based in Germany (European Citizen Science Association, Berlin). Figure 1 shows a map of our SEEDS partners and their relevant and complementary competences.

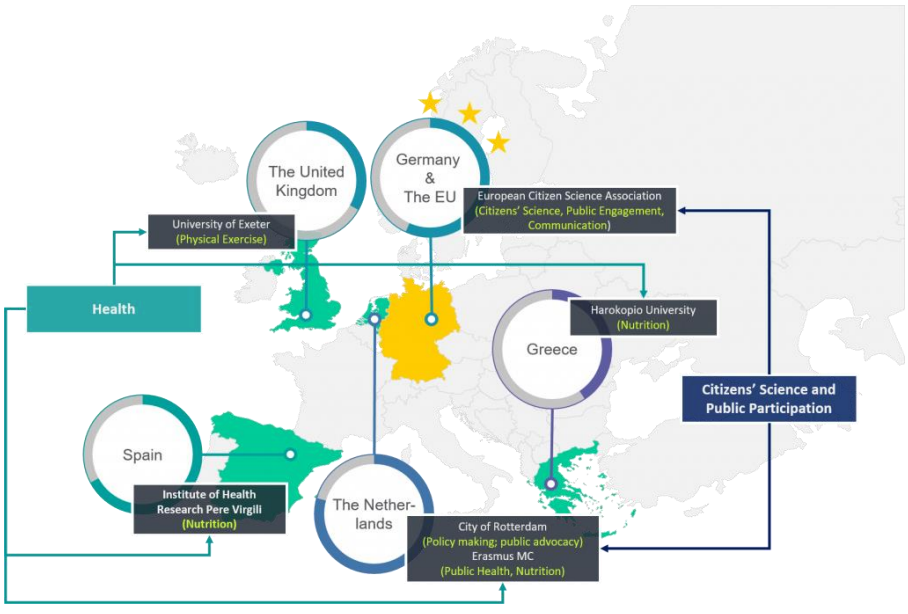

Figure 1. The SEEDS consortium partners and their expertise.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

Greece, Spain, The Netherlands and the United Kingdom (UK) are the four pilot countries where interventions will be designed and implemented.

1.1.2. Study design and participants in the SEEDS project

SEEDS is a multi-country cluster randomised controlled trial (c-RCT). High schools from low socioeconomic areas were recruited and were randomised at a ratio of 1:1 within each country. The low socioeconomic areas were detected by country specific methods. The allocation was not blinded due to the nature of the intervention.

Three different groups of people participated in SEEDS:

- Adolescents: All participating adolescents from high schools, from both intervention and control schools, completed the questionnaires before and after the intervention.
- Ambassadors: In each country, 16-21 adolescents from intervention high schools were selected and they were called ambassadors. Ambassadors participated in focus groups, Makeathons, implementation of the intervention and the final exchange in Brussels.
- Stakeholders: Important members of the Quadruple Helix relevant to the outcomes were involved. The SEEDS project is rooted in the Quadruple Helix model (1) and was connected to key members in science and society from Government, Community, Business, and Academia. Various stakeholders participated in focus groups and Makeathons and were involved in the implementation of interventions.

1.1.3. Phases of the SEEDS project

The SEEDS project consisted of five different phases. In phase 1, high schools, ambassadors and stakeholders were recruited. In phase 2, focus groups with ambassadors and stakeholders were conducted to gain insights into the barriers and facilitators of key behaviours related to healthy and active living, the role of science and technology to create a change in this and the role of stakeholders to engage adolescents in healthy lifestyle behaviour. The results of those focus groups have been used to guide the Makeathons and the intervention phase, defining also the primary and secondary outcomes and composing the questionnaire for pre- and post-measurement. In phase 3, all adolescents from intervention and control schools completed questionnaires related to healthy and active living and STEM outcomes at baseline (before Makeathons in November-December 2021) and at follow-up (June-July 2022). Also, a process evaluation of the SEEDS project was conducted using information on the course and results of the Makeathons as well as on the implementation of the intervention. In phase 4, Makeathons were organised to facilitate the co-creation of interventions by teams of ambassadors, adolescents and stakeholders. Afterwards, each country implemented an intervention to improve determinants or health behaviours. Finally, in phase 5 the ambassadors travelled to Brussels to disseminate the project and exchange their experiences with the ambassadors and researchers from other countries.

The focus groups, questionnaires and Makeathons are elaborately described in respectively Deliverable 2.1, 2.2 and 4.1.

1.1.4. Overview of the SEEDS interventions

Adolescents were in the lead of designing SEEDS interventions during SEEDS Makeathons. SEEDS Makeathons were creative, collaborative 2- to 4-hour challenges that bring together students and stakeholders from different backgrounds (described in Deliverable 2.1). SEEDS Makeathons were organized with adolescents and key stakeholders to create novel intervention ideas regarding physical activity (PA) and healthy nutrition.

After collecting all the ideas of the Makeathons, a multi-component intervention per pilot country was created. All interventions consisted of different activities focusing primarily on the encouragement of PA during school hours and the encouragement of healthy nutrition during and after school hours. The Greek intervention focused on changing the school canteen by adding healthier food choices and providing more variety in physical education (PE) classes. The Spanish intervention focused on an educational program about healthy and active living, class-level competitions to reduce screen time, cooking workshops and the free delivery of fruit one time per week to promote healthy snacking and active class and pauses and a sport day to promote PA in high school. The Dutch intervention consisted of sports workshops, cooking workshops, the organisation of break time PA activities, a 10-lesson educational program about healthy nutrition, and the creation of a healthy school canteen. The UK intervention provided an intervention pack with increased frequency and intensity of activities during the whole intervention period, week-by-week and month-by-month. The intervention focused on drinking water, increasing healthy snacks, reducing screen time and doing PA, in particular skipping and increasing participation in PE class.

All interventions are elaborately described in Deliverable 3.1 and Deliverable 3.2.

1.2. Content of this deliverable

In this deliverable we focus on the impact and process evaluation of the SEEDS project and interventions. Effect evaluation was based on questionnaires completed by the students before and after the intervention. The process and impact evaluation were based on student evaluation questions during the Makeathon, a questionnaire completed by the students after the intervention and input from students and stakeholders during the Brussels exchange in October 2022. This deliverable will provide some preliminary results of the SEEDS project.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

2. EFFECT EVALUATION

2.1. Methodology

2.1.1. SEEDS questionnaire

The SEEDS questionnaire included some demographic questions, like gender and age (2). Concerning lifestyle-related outcomes, we used a selection of validated questions of the HBSC study (2) and Physical Activity Questionnaire for Children (PAQ-C) (3). Regarding STEM outcomes, interest in life science was assessed by a selection of questions from the validated STEM interest survey (4), "Scientific Capital" was assessed by a selection of questions from the validated Science Capital Survey (5) and interest in STEM career pathways was assessed by a selection of questions from the validated Attitude towards STEM questionnaire (6).

We identified four primary outcomes to determine the study effects. Regarding PA, this is the question about the number of days per week individuals are being physically active for at least 60 minutes per day (2). Regarding fruit and vegetable consumption, those are two questions about the number of days a week that they respectively eat fruit or vegetables during school hours (2). To measure STEM effects, we identified the question "I would like to have a job that uses science" as primary outcome (5).

2.1.2. Statistical analysis

Continuous variables that were normally distributed were presented as mean ± SD. Normality was evaluated using the P–P plots. Categorical variables were presented as frequencies. Associations between categorical variables were tested by the calculation of chi-squared test. Student's t test for independent samples and one-way ANOVA were used to evaluate mean differences of the normally distributed variables (i.e., age) between the intervention and control group. Multiple imputation techniques were used to handle missing data and a number of datasets were generated based on the amount of missing data. The effectiveness of the intervention was evaluated using a multilevel mixed model controlling for sociodemographic characteristics (age, gender, country) and taking clustering at the school-level into account. The intra-cluster correlation coefficients were calculated. A two-tailed P value was considered significant at the 5% level. Statistical calculations were performed with SPSS 25 software (SPSS Inc., Chicago, IL, USA).

2.2. Preliminary results

2.2.1. Study population characteristics

In **Table 1** the basic characteristics of the study participants are presented. Of the 1208 adolescents recruited at baseline 49% (n = 589) joined the intervention group and 51% (n = 619) the control group. Adolescents in both groups were of similar age, in intervention and control

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

group mean age was respectively 14.5 and 14.4 years old. Regarding gender, in the intervention group 49% (n= 286) were girls and 48% (n= 282) were boys, while in the control group 54% (n= 333) were girls and 44% (n= 275) were boys.

Table 1. Distribution of participants' characteristics by study group at baseline

		Intervention	Control	*p*
N		589	619	
Age (years) (mean± standard deviation)		14.5 ± 0.9	14.4 ± 0.8	NS
Gender, (n. %)				NS
	Boys	282 (47.8%)	275 (44.4%)	
	Girls	286 (48.6%)	333 (53.8%)	
	Other	21 (3.6%)	11 (1.8%)	

The reported p values were calculated using the t test and the chi-square test.
NS = non-significant (>0.05)

2.2.2. Results on lifestyle

Preliminary results on lifestyle are presented in Table 2 for 1208 participants who completed measurements for baseline and follow-up. At baseline, the mean number of days adolescents were physically active for at least 60 minutes per day over the past 7 days at baseline was 3.9 days/week and 4.0 days/week for the intervention and control group, respectively. A non-significant increase in number of days being physically active for the intervention group was observed between baseline and follow-up, while for the control group there was no change observed. This difference between groups was not statistically significant.

Concerning the days per week that the participants usually ate fruit during school hours, at baseline both the intervention and control group consumed fruit for 2.1 days/week. Whereas the intervention group slightly increased their fruit consumption, this decreased in the control group. However, those changes and the difference between groups were not significant.

For vegetable consumption (days/week) during school hours, at baseline the intervention group consumed vegetables for 1.2 days/week, whereas this was 1.5 days/week for the control group. The mean value increased for the intervention group, with the difference between groups to be statistically significant.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

Table 2. Primary outcomes on physical activity and dietary factors at baseline and follow-up.

Pre and post-results	Intervention		Control		
	Baseline	Follow-up	Baseline	Follow-up	
Measurement	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	*p*
Weekly physical activity (days/week)	3.9 (2.1)	4.4 (2.2)	4.0 (2.2)	4.0 (2.1)	*NS*
Consumption of fruits during school hours (days/week)	2.1 (2.0)	2.2 (1.9)	2.1 (2)	1.8 (1.9)	*NS*
Consumption of vegetables during school hours (days/week)	1.2 (1.8)	1.6 (1.9)	1.5 (1.9)	1.5 (1.8)	*<0.05*

The multilevel mixed model was controlled for age, gender, country and school-clusters.
NS = non-significant (>0.05)

2.2.3. Results on STEM

Preliminary results on STEM are presented in Table 3 for 1208 participants who completed measurements for baseline and follow-up. Effect on STEM was based on the question "I would like to have a job that uses science", which has been answered on a 5-point Likert scale of agreement. STEM outcome did not change over time for both intervention and control group, with the difference between groups not being statistically significant.

Table 3. STEM outcomes at baseline and follow-up.

Pre and post-results	Intervention		Control		
	Baseline	Follow-up	Baseline	Follow-up	
Measurement	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	*p*
"I would like to have a job that uses science"	2.8 (1.3)	2.7 (1.3)	2.9 (1.2)	2.8 (1.3)	*NS*

The multilevel mixed model was controlled for age, gender, country and school-clusters.
NS = non-significant (>0.05)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

3. PROCESS AND IMPACT EVALUATION

3.1. Results on recruitment and reach

Over the course of the SEEDS project several inroads have been made with regards to recruitment into the study, from the perspective of schools, adolescents, stakeholders, and overall reach of the project. Recruitment and reach of schools, adolescents and stakeholders has been described Deliverable 3.2. Figure 2 shows the flowchart of the SEEDS study with the amount of schools, adolescents and stakeholders involved.

3.1.1. Recruitment and reach of schools

Regarding the recruitment of schools, this exceeded Key Performance Indicator targets and minimum requirements (22 schools in total), with a total of 26 schools recruited in the SEEDS study, including 12 intervention schools and 14 control schools. Participating high schools were enthusiastic about the goals of the SEEDS project and the opportunities it would bring for their students. However, due to the citizen science approach used in the project, some schools contacted were hesitant to participate as they did not know what to expect exactly. The Covid-19 pandemic also influenced the recruitment process, for example there was reduced access of external members to schools and schools mainly focussed on completing their regular curriculum instead of extra activities. Schools also highlighted the limited time available for teachers to commit to this study.

3.1.2. Recruitment and reach of adolescents who participated in the effect study

As shown in Figure 2, more adolescents were reached during the SEEDS project, compared to the number of adolescents who participated in the assessment. In total 1208 participants completed the baseline questionnaire. The number of participants with additional follow-up data is lower at 840. One of the main reasons why we do not have questionnaire data from all adolescents reached with the interventions is the consent we had to gain from both students and their parents/carers. Adolescents who did not gave permission themselves and/or without parental permission did not participate in the assessment, neither at baseline nor follow-up assessment. Furthermore, the Covid-19 pandemic caused forced closure of schools or complete classes during both baseline and follow-up assessment period. Therefore, initial permissions to collect data was lost as well as matches between baseline and follow-up measurements.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

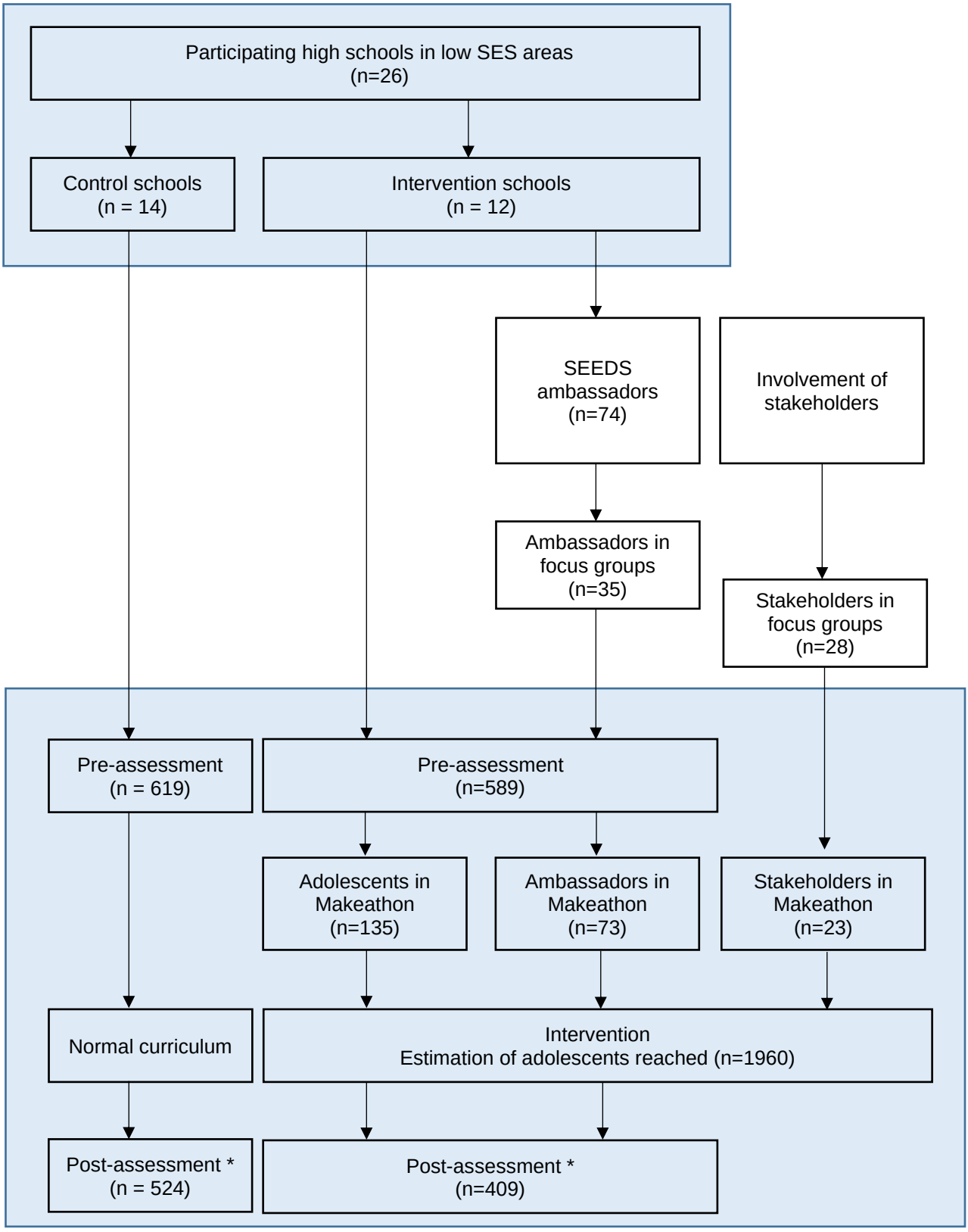

Figure 2. Flowchart of the SEEDS study.

** In total 933 participants had follow-up data, but only 840 participants had data on both baseline and follow-up and were therefore included in the effect analysis.*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

3.1.3. Recruitment and reach of stakeholders

Recruitment of stakeholders was a much easier process. They were very interested and engaged with the SEEDS project. In total, 28 stakeholders participated in the focus groups (see Table 4) and 21 participated in the Makeathon events. The main issue regarding stakeholder recruitment was time and their own workload, and it was sometimes difficult to find a time for the stakeholders and academics to meet.

Table 4. Participating stakeholders in the focus groups.

Country	Type of stakeholders
Greece (1 FG, n=5)	• High school principal • High school canteen owner • Physical activity teacher • Home economics teacher (this lesson includes nutrition modules) • Teacher responsible for breaks (safety reasons)
Spain (2 FG, n=10)	• Physical activity teacher in high school and sports campus monitor • Policymaker of the health promotion service in a public health agency of Catalonia • Social integrator of a high school • Worker in a youth association in Reus • Member of Caritas Tarragona Association (Official confederation of charitable and social action entities of the Catholic Church in Spain), and retired university professor • Member of the central market of Reus • Policymaker of educational services (Department of Education of Catalonia) • Pedagogue and expert in health promotion • Council of youth and citizen participation and, of rural environment • Teacher at a unit of shared schooling
The Netherlands (2 FG, n=11)	• Municipal project leader for childhood fitness and obesity prevention programme • Municipal policy advisor • 2 youth workers at youth foundation • Preventive youth health nurse • Municipal strategic advisor sports • Municipal district advisor • Employee of sport facilitating agency • PE teacher and project leader at school for childhood fitness and obesity prevention program • Youth worker at a welfare organisation • Researcher at sport supporting agency
United Kingdom (1 FG, n=2)	• Head of science department at intervention high school • South West UK representative of STEM charity

FG = focus group

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

3.1.4. Reach on social media

The SEEDS projects also aimed to reach the broader public via its website (https://seedsmakeathons.com) and its Twitter account (@SMakeathons). The reach of the SEEDS project on Twitter is presented in Table 5. More information about the dissemination and communication of the SEEDS project via the website can be found in Deliverable 5.2.

Table 5. Reach of the SEEDS project on Twitter.

Date	Twitter Followers	Twitter Impressions
Sep 2021	42	19,100
May 2022	175	43,360
Jul 2022	219	56,289
Oct 2022	246	70,065
Dec 2022	261	80,031

3.2. Results on co-creation process

Co-creation was a central theme throughout the duration of the SEEDS project. Although SEEDS researchers were largely responsible for the overall positioning of the research and the project, at virtually every stage of the project, collaboration with the students and adult stakeholders took place.

3.2.1. Makeathon events

Every country in the SEEDS consortium conducted a Makeathon with academics from each institution running the event with SEEDS ambassadors and stakeholders from the respective countries in attendance. There is no standardised approach to sharing the 'results' of these events as the end points are not easily defined. For example, the goal of the Makeathon was to devise the intervention that would run in each school in each respective SEEDS country, however, there is actually a lot more to report on when considering what went into devising the experiment. Considering these points, it is important to point out that there were aspects discussed in each Makeathon that did not make it into the final intervention. A total of 8 Makeathons were conducted, two in Greece, four in Spain, one in The Netherlands and one in the United Kingdom.

Each of these countries opted to run the Makeathon component of the project in slightly different ways – with some countries choosing to run multiple Makeathons and there being differing total numbers of attendees. The makeup of stakeholders varied in each of the Makeathons, but we tried to involve a variety of different expertise as support for the adolescents during the Makeathon. For example, in The Netherlands stakeholders from different expertise were involved, like nutrition and PA advisors or a youth health worker. In addition, in Spain stakeholders from

nutrition and PA expertise, members of youth associations, board members of the high schools and members of parents associations were involved. During each Makeathon young researchers, bachelor and masters' students, from each institute were involved as facilitators (31 in total).

From speaking to the UK ambassadors who attended the conference in Brussels, many commented on the fact they particularly enjoyed the Makeathons. This was reflected by participants from virtually every school from every country that attended the Brussels conference.

In terms of the aspects that adolescent participants did not like as much essentially revolved around their perceptions of performative pressures. For example, there were several participants who mentioned they were, initially, uncomfortable speaking to other students about the intervention in their own school, as well as talking during the Brussels conference.

The Makeathon events were very successful co-creation processes and in the large majority went very well. However, some issues were identified including difficulties for the opinions of all participants to be heard. Indeed, some participants had dominant personalities and were very confident talking in front of their peers, which was great, however it meant that some of the quieter adolescents did not have as many opportunities to share their ideas and opinions. It was also sometimes challenging for the teachers and researchers not to intervene and let the adolescents guide the conversations. Future Makeathon events may want to develop different ways to engage all ambassadors, perhaps including some digital anonymous questionnaires to engage all participants in the process.

3.2.2. Evaluation questions of the Makeathon events

The SEEDS consortium wanted to gain basic insights into the ambassador and stakeholder enjoyment and views pertaining to the Makeathon event. Thus, all participants in the Makeathons from all countries were asked to rate their experience of the Makeathons. As the Makeathon was already speech and writing intensive a simple voting methodology was opted for. Each participant was provided with two tokens – ambassadors were given different tokens to that of the stakeholders – and were instructed to place their token in a box which most closely reflected their enjoyment of the Makeathon and opinion on their views being taken seriously during the Makeathon. The questions were as follows:

Enjoyment

I enjoyed participating in the Makeathon.

Views

My views were taken seriously in the Makeathon.

There were five identical boxes arranged at opposite sections of the room and the intention was to determine participants' overall agreement/satisfaction with these questions. Consequently, a

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

simple 'Likert' scale was introduced – we opted to use simple cartoon faces to signal agreement, indifference, or disagreement (see Figure 3).

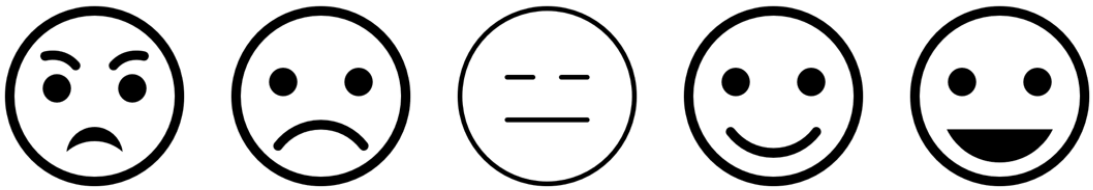

Figure 3. Smiley-face Likert-scale used in Makeathon evaluation questions.

We devised strategies to prevent participants from influencing one another. For example, we organised the voting session so that participants were not aware of what was going to happen. Also, we revealed at the very last moment what we wanted the participants to do – and we did this without revealing exactly what the questions were. Importantly, we organised the session so that participants would not be able to communicate with one another about the questions.

3.2.3. Results from Makeathon evaluation questions

For each country, when considering the enjoyment aspects of the day, most adolescents said they "really liked", "liked", or "didn't mind" participating in the Makeathons (see Table 6). The same pattern was observed when considering adolescents' insights into how seriously their opinions were taken during the event, with most adolescents responding with "very seriously" or "seriously". In contrast, some adolescents mentioned their opinions have not been taken seriously at the Makeathon (at all), but this was a really small number of participants across countries.

In terms of the stakeholders who cast votes at the end of the Makeathons, the overall pattern of the results was similar to those of the adolescents and there were no differences in patterns between countries (see Table 6). Most stakeholders reported having "really liked" or "liked" the Makeathons, with no stakeholders stating they "didn't like" or "really didn't like" the Makeathons. Similarly, there were more instances where the stakeholders revealed their responses were taken "very seriously" or "seriously" and none indicated in their responses that their "opinions have not been taken seriously at the Makeathon".

Results from Makeathon evaluation questions highlighted positive results for both adolescents and stakeholders in all countries.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

Table 6. Adolescents' and stakeholders' responses to Makeathon evaluation questions from 4 pilot countries.

	Adolescents (n=207)			**Stakeholders** (n=14)		
	n	*%*	*Mean score*	*n*	*%*	*Mean score*
Question 1: enjoyment			4.47			4.64
I really liked to participate in the Makeathon	127	61.4		9	64.3	
I liked to participate in the Makeathon	57	27.5		5	35.7	
I didn't mind to participate in the Makeathon	19	9.2		-	-	
I didn't like to participate in the Makeathon	1	0.5		-	-	
I really didn't like to participate in the Makeathon	3	1.5		-	-	
Question 2: co-creation			4.24			4.57
My opinions have been taken very seriously at the Makeathon	113	54.6		9	64.3	
My opinions have been taken seriously at the Makeathon	50	24.2		4	28.6	
I feel indifferent as how my opinions have been taken at the Makeathon	30	14.5		1	7.1	
My opinions have not been taken seriously at the Makeathon	9	4.3		-	-	
My opinions have not been taken seriously at all at the Makeathon	5	2.4		-	-	

3.3. Results on implementation of the interventions and stakeholders' collaboration

3.3.1. Interventions

Interventions were developed and implemented by the four pilot countries. A detailed breakdown of each intervention per country is available in Deliverable 3.1. and Deliverable 3.2. A brief summary on the different interventions is presented in Table 7.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

Table 7. Brief summary of the SEEDS interventions per country.

Country	Summary of the interventions
Greece	• Duration: 5 months – January 2022-May 2022 • New healthier snack choices at the school canteen (e.g. make water a main drink) and promotion of these among pupils (twice a week) • New equipment and increased variety of PE class activities (twice a week) • Creation and distribution of a leaflet to promote healthy snacking and physical activity
Spain	• Duration: 5 months – January 2022-May 2022 • Training for adolescents and parents, as well as a webinar regarding healthy snacks, PA and screen time • Workshop on healthy snacks • Competition of healthy snacks • Free fruit at recess every 15 days • Active classes once a month • Active pause between class (video of 2-3 minutes) once every 15 days • Sports day • Competition of screen time
The Netherlands	• Duration: 4 months – March 2022-June 2022 • Healthy school canteen • Lesson package regarding healthy eating and home-cooking exercise • Cooking workshops • Workshops for new sports (during PE class or in extra hours) • More youth-led physical activity opportunities during breaks • Competition elements on physical activity and healthy food
United Kingdom	• Duration: 4 months – March 2022-June 2022 • Get active ≥10-20 minutes, 1-4 times per week • Actively participate in PE classes • Participate in one new sporting activity and learn to skip • Make water the only hydration drinks • Eat a healthy snack • Complete a monthly diary and STEM task

The issues encountered centred around the fact that the Covid-19 pandemic affected the recruitment and delivery of the intervention. Although allowances were continually made for Covid-19, it is difficult to articulate exactly how disruptive the pandemic was. The main area where this caused the biggest problem pertained to access to schools. For example, there were delays in conducting the pre-intervention evaluation questionnaires in both intervention and control schools, as sometimes schools decided they were not going to allow anyone who was not an essential member of staff onto the premises. Although these issues were eventually traversed, this had a significant influence.

It was important for all SEEDS countries to have a degree of coordination between one another in terms of the start and end times of their interventions. Initially, the interventions were planned to run from January 2022 to June 2022, however the aforementioned Covid-19 pandemic as well as the fact that some countries experienced problems with having later than anticipated Makeathons, meant that different countries needed to stagger the start times of the interventions. Also, development time of interventions and research logistics were reasons for not being able to start in January with all planned intervention activities. This meant having to remove or reduce components to shorten the timeframe of the interventions. Using the UK interventions as an example this meant having to make some changes to reduce the duration by two months, resulting in a four-month intervention instead of a duration of six months. This posed a problem because decisions needed to be made with respect to what should be removed to provide a relevant experience to those participating, while allowing for the shorter duration, but also resembling the complete experiment.

Other issues identified during the intervention processes included the limited engagement and motivation of adolescents. Indeed, both adolescent ambassadors and stakeholders reported that at the beginning of the study, adolescents and their teachers were really interested and engaged in the study, but this decreased as the study went on. Adolescents highlighted that it was difficult to keep motivated in making those behavioural changes and challenging to motivate their peers. In the Brussels exchange meeting, adolescent ambassadors and stakeholders highlighted the need for greater motivation strategies, and this should be considered in future studies.

3.3.2. Stakeholder involvement in implementation

Stakeholders represented a contact point for SEEDS academics to communicate with at all stages of the research, and to help organise things like the school visits or the administration of the surveys.

The primary stakeholders involved in the implementation of the SEEDS intervention were school staff. Often, they were members of the school staff who had links to the project because they were approached by SEEDS academics for inclusion into the project. This also meant that there was a high chance this member of staff was linked to the core components of the SEEDS project – STEM or PE teachers.

The SEEDS project managed to collaborate with stakeholders beyond the scope of the school setting. Indeed, additional external stakeholders participated in the implementation of the SEEDS interventions. For example, external stakeholders included a representative from a charity specialising in STEM education in the UK, a high school canteen owner in Greece and youth workers in The Netherlands and Spain. Detailed stakeholder involvement during the implementation of SEEDS interventions has been elaborately described in Deliverable 3.1 and Deliverable 3.2.

Some stakeholders participated in a more 'hands-on' way throughout the project. For example, in the UK, one of the stakeholders attended an exercise class with the SEEDS ambassadors every morning during the intervention. It was interesting to speak to them as they commented on the fact that they felt so much better in themselves for engaging in 15 minutes of exercise every morning before the school day. In The Netherlands, part of the intervention consisted of a collaboration with an external professional to provide cooking workshops – teaching pupils how to prepare healthy food. In Spain, an external professional of nutrition education workshops provided the cooking workshops, a PE professional provided the videos for the active pauses and trainers of leisure time PA collaborated to organize the sports day.

Importantly, the SEEDS stakeholders represented an adult/professional insight into the overall progress of the project.

Stakeholders were engaging with the SEEDS academics, helpful, motivated in involving and recruiting adolescents, and always keen to provide required information to both students and SEEDS academics. However, some difficulties in the involvement of stakeholders in the implementation of the SEEDS project were noticed, with the main issue being time. Indeed, given the pre-existing workload of teaching staff, there were limits on the investment everyone was able to make in the SEEDS project. Other difficulties included the restricted schools' access to external stakeholders due to Covid-19 rules, and the requirement for specific committee approvals.

3.4. Questionnaire evaluation questions

3.4.1. Evaluation questions in the final questionnaire

Several evaluation-based questions were added to the end of the follow-up SEEDS survey. These questions were only distributed to the intervention schools. As each one of the SEEDS consortium countries was running a slightly different intervention, these process evaluation questionnaires needed to be specific to the actual intervention ran in each location. The different components and/or activities from each intervention were specified in questions 2 and 3 of the process evaluation questionnaire (Table 8).

Table 8. Structure of the process evaluation questions with examples from the UK survey.

1. Did you participate as an ambassador in the SEEDS project? • Yes • No
2. In which SEEDS activities did you participate? *Please note these answer options would have been adapted for the specifics of each intervention in each country.* • I participated more in PE classes • I learned to use my skipping rope

- I drank more water during the school day
- I made healthier eating decisions
- I reduced my screen time

3. Choose which response best represents your answer (strongly disagree, disagree, neither agree nor disagree, agree, strongly agree).

Please note these questions would have been adapted for the specifics of each intervention in each country.

In the coming years, I would like to remain…

- … in a programme that encourages more participation in PE classes.
- … in a programme that encourages me to learn new skills, like skipping.
- … in a programme that encourages me to drink more water during the school day.
- … in a programme that encourages me to make healthier eating decisions.
- … in a programme that encourages me to reduce my screen time.

Structuring these questions in this way meant it was possible to determine any differences in the views and opinions on the separate components of the intervention from the perspective of SEEDS ambassadors and adolescent participants. Results from the process evaluation questionnaire are presented in Table 9. In summary, between 56.4% and 91.9% of adolescents participated in at least one activity during the intervention. In Greece, participation rates in at least one activity were lower compared to the other countries, but the increased variety of activities in PE classes was the most performed activity. In Spain, adolescents were really engaged with most activities, but particularly with the training in healthy snacks, physical activity, screen time and the workshop on healthy snacks. In The Netherlands, adolescents particularly engaged with the cooking workshops and cooking exercises at schools. Originally, the cooking workshops in schools would have been separate from the workshops (in school and at home), but in the end only cooking workshops were organized. Therefore, students might have filled in they joined the cooking exercises, but instead they joined the cooking workshops. Cooking workshops were highly appreciated by the Dutch students. In the UK, the water intervention was the most popular. It should be highlighted that numbers reported in Table 9 represent the activity participation of people who completed this questionnaire. Thus, the actual participation numbers may differ. Numbers regarding actual participation in the different activities can be found in Deliverable 3.2.

Table 9. Participation in activities of the SEEDS interventions per country.

	Greece (n=50)		**Spain** (n=185)		**The Netherlands** (n=55)		**United Kingdom** (n=111)	
Participated as ambassador	7.7%		37.6%		16.7%		22.0%	
Participated in at least 1 activity	56.4%		91.9%		74.5%		82.9%	
Specific activities								
	Variety activities in PE classes	55.6%	Training healthy snacks, PA, screen time	82.9%	Cooking exercise at school	34.5%	Drinking more water	46.7%
	Leaflet for nutrition and physical activity	25.9%	Workshop healthy snacks	81.2%	Cooking workshops	25.5%	PE classes	19.6%
	Healthier food choices in school canteen	18.5%	Service of free fruit	71.2%	Project group nutrition	10.9%	Skipping	15.2%
			Screen time competition	64.7%	Cooking exercise at home	10.9%	Healthy eating decisions	9.8%
			Sports day	61.8%	Help to create the healthy school canteen	9.1%	Reducing screen time	8.7%
			Healthy snacks competition	61.2%	Sport tournaments	9.1%		
			Active classes and active pauses	47.1%	Sport workshop during PE class	7.3%		
					Project group PA	5.5%		
					Sport workshop in extra hours	3.6%		

The process evaluation questionnaire also assessed whether adolescents would like the different activities to be maintained. Results are presented in Table 10. It appears that there are some components of each intervention that participants would be more willing to continue after the SEEDS project ends. There are also aspects of the intervention that participants would not want to continue. In Greece, participants enjoyed the use of leaflets to teach pupils about healthy lifestyle decisions, however they were less interested in receiving more in person training about healthy lifestyles. In Spain, participants wish to maintain the sports day, but they are less inclined to engage with continual training regarding healthy lifestyle choices. In The Netherlands, adolescents enjoyed the provision of cooking workshops, but they were less interested in helping create a school canteen. In the UK, adolescents wish to maintain drinking more water, but they are less inclined to continue using the skipping ropes.

Table 10. Adolescents' wish to maintain activities of the SEEDS interventions per country.

	Strongly disagree (1)	Disagree (2)	Neither agree nor disagree (3)	Agree (4)	Strongly agree (5)	Mean score
Greece						
Leaflet for nutrition and physical activity	-	-	25.6%	39.5%	34.9%	4.09
Variety activities in PE classes	-	7.0%	20.9%	41.9%	30.2%	3.95
Healthier food choices in school canteen	-	7.0%	27.9%	41.9%	23.3%	3.81
Spain						
Sports day	9.4%	4.1%	21.2%	30.0%	35.3%	3.78
Service of free fruit	7.1%	5.3%	20.6%	37.1%	30.0%	3.78
Workshop healthy snacks	8.8%	5.3%	21.8%	34.7%	29.4%	3.71
Active classes and active pauses	11.8%	6.5%	28.2%	28.8%	24.7%	3.48
Healthy snacks competition	11.8%	6.5%	26.5%	37.6%	17.6%	3.43
Training healthy snacks, PA, screen time	13.5%	4.1%	28.2%	35.3%	18.8%	3.42
Screen time competition	11.2%	8.2%	34.1%	31.8%	14.7%	3.31
The Netherlands						

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

Cooking workshops	10.3%	13.8%	17.2%	20.7%	37.9%	3.62
Cooking exercise at school	14.3%	23.8%	4.8%	33.3%	23.8%	3.29
Project group nutrition	12.5%	16.7%	20.8%	37.5%	12.5%	3.21
Project group PA	9.5%	14.3%	38.1%	33.3%	4.8%	3.10
Sport workshop in extra hours	18.5%	18.5%	25.9%	14.8%	22.2%	3.04
Sport workshop during PE class	5.3%	36.8%	15.8%	36.8%	5.3%	3.00
Cooking exercise at home	18.8%	12.5%	37.5%	18.8%	12.5%	2.94
Help to create the healthy school canteen	-	42.9%	28.6%	28.6%	-	2.86
Sport tournaments	21.1%	36.8%	5.3%	21.1%	15.8%	2.74
United Kingdom						
Drinking more water	9.4%	8.5%	32.1%	32.1%	17.9%	3.41
Healthier eating decisions	10.4%	8.5%	35.8%	25.5%	19.8%	3.36
PE classes	14.3%	10.5%	29.5%	29.5%	16.2%	3.23
Reducing screen time	13.3%	12.4%	39.0%	21.9%	13.3%	3.10
Skipping	15.1%	11.3%	40.6%	20.8%	12.3%	3.04

Missing data on those questions has been removed when calculating the percentages.

3.5. Brussels exchange input on process evaluation

At the end of the SEEDS project, the exchange in Brussels enabled both adolescents and stakeholders to reflect on different aspects of what worked well and what did not over the last two years.

3.5.1. Ambassadors and SEEDS participants

Throughout the Brussels exchange, adolescents were very engaged. This also transpired during the parallel sessions of the SEEDS Brussels conference, where adolescents had the opportunities to discuss various topics, the things they enjoyed and the things they would like to change.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

Participants reflected on the fact that they really enjoyed participating in the Makeathon element of the SEEDS project – noting that being able to visit an academic institution and having an opportunity to collaborate with academics was enjoyable for them. Some adolescents highlighted that they particularly enjoyed the teamwork, creativity and sharing of ideas. However, others identified time as being an issue and reported that they did not have enough time to think, talk about all the different ideas or to implement them in their schools. Teenagers advised that more time needs to be allowed during the Makeathons and/or more meetings are necessary to develop the adolescents' intervention ideas, but at the same time, some ambassadors highlighted the necessity of more pauses during the Makeathon because they feel exhausted at the end of the session.

Participants also discussed the fact that they enjoyed engaging in the intervention over the 4–6 month period and that they would very much enjoy and like for some variant of the SEEDS project to continue in their schools after the project is over. However, participants discussed that a major thing that schools will need to do is to motivate and convince pupils to engage with these activities, as corroborated by the shared frustrations of SEEDS ambassadors when trying to motivate the non-ambassadors to engage in the interventions.

Teenagers identified some topics they would like to include in a future intervention, including how being healthy impacts the body, what happens to the body when processing foods, and climate change.

Adolescents really enjoyed the Brussels exchange trip and meeting people from other countries. Indeed, participants from all countries mentioned they enjoyed speaking to pupils from other locations in the world. However, sometimes, language became a barrier. Indeed, a prominent theme discussed by the UK cohort was their lack of ability to communicate in another language. This issue presented itself several times throughout the time spent in Brussels. It is also important to note that although we made allowances for the different languages that were spoken, it might be difficult to fully appreciate the nuances of the perspectives offered by non-English speaking participants. Participants often wished that there were more opportunities to meet and collaborate with students from other countries. Adolescents also highlighted that it would be good if this multi-country exchange occurred earlier during the project, perhaps during the co-creation process. Participants highlighted that this would be more motivating, as well as starting to create bonds and friendships with other students in other countries.

3.5.2. SEEDS Stakeholders

There were several teachers accompanying SEEDS ambassadors and SEEDS participants on the Brussels trip – it was apparent from speaking to them that these teachers saw the benefit of the project. Several of them discussed what a massive opportunity the Brussels trip, along with the rest of the SEEDS project, represented for the students and how this was such an amazing opportunity for them.

Regarding the Makeathons, stakeholders highlighted that these events were fun for the adolescents, allowing for brainstorming, freedom of thinking and motivation for the study. Stakeholders agreed that projects like SEEDS should continue and identified different subjects that could be included in future Makeathons including food waste, recycling, screen time, digital skills and mental health. Some stakeholders mentioned that it may be helpful to give feedback during the Makeathons, for example using 'Mentimeter', allowing interactions with the audience and real-time voting.

Stakeholders identified local governments, councils, management of schools, researchers, youth workers, families and communities as important facilitators and stakeholders to support these activities. Future projects may want to involve all of these different key players for a successful project.

Regarding the implementation of interventions, stakeholders identified time as the main barrier. They highlighted that their time is limited, and it was difficult for them to involve all of the pupils in the schools, as well as prepare the intervention, explain it to students and make sure it had been understood. Some stakeholders also highlighted that time and motivation are linked, and if time is restricted, the motivation may be low as well. Although maintaining adolescents' motivation throughout the study was emphasised many times, it was also recognised that the teachers and stakeholders' motivation is also key.

Stakeholders had some ideas on how to involve more schools and spread the SEEDS ideas including for academics and/or ambassadors to go to different schools to present the projects, as well as involving different kinds of schools, perhaps in different parts of the city/country and of different socioeconomic status.

When questioned about the impact of the SEEDS project on students' healthy lifestyle behaviours, stakeholders emphasised that this study was a start, that it had some impact on the ambassadors' healthy lifestyle behaviours, but that this may not necessarily be applicable to all students, and these changes may not last once the SEEDS project comes to an end. Stakeholders highlighted that for changes to last, activities need to be regular, and the school leadership should be involved. Mainly, stakeholders stressed that a motivator is needed, and future projects should aim to identify one.

The main challenges faced by stakeholders and academics whilst organising this Brussels exchange included the organisation and ethics approvals needed to transport students to Brussels. Money and financing this kind of project is also a limiting factor.

Ultimately, the SEEDS Brussels exchange was a great success, giving the opportunity for adolescents to travel abroad, sometimes for the first time, meeting different people, experiencing different languages and cultures and getting the satisfaction of being part of something important. For academics, the Brussels exchange was a great source of feedback, positive and negative, as

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

well as ideas and improvements for future studies, both from the adolescents and the stakeholders.

3.6. Institutional impact

Within the SEEDS project, various institutions were involved. First of all the schools who participated in the project offered their students healthy lifestyle engaging activities and opportunities to participate in research as an ambassador, a chance they do not get regularly. Furthermore, we engaged with stakeholders from various expertise and different institutions and shared the SEEDS approach, like the Makeathon events. By means of presentations during or contribution to for example webinars, conferences or panel discussions, we shared the SEEDS project among other institutions. Lastly, we created impact within our own organisations. About 22 researchers, policy advisors, project managers and communication specialists have been actively engaging in the SEEDS consortium over the past two years of which at least 4 PhD students. Four master-students and interns have been working on the SEEDS project as well. We shared the SEEDS project within our organizations and some young researchers, bachelor- or master-students had a facilitating role in the Makeathon events. Experiences were very positive among stakeholders and researchers from all different institutions.

In terms of additional institutional impact, the SEEDS project has provided foundations for a significant amount of future direction in academic research within the consortium. For example, the notions of widening participation and citizen science are now techniques that can be used as a suite of methodologies within the complete portfolio of procedures that are available to researchers and policy advisors. In addition to this, as SEEDS partners are now familiar with widening participation and citizen science approaches, researchers will also be able to collaborate with other academics and help them in running similar projects in the future. Finally, SEEDS has strengthened awareness and our commitment to inclusion and diversity, towards listening to the many people who very often lack a voice in our society.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

4. CONCLUSIONS

This deliverable provides the preliminary results on effect, impact and process evaluation of the SEEDS project. Four primary outcomes were analysed. Regarding intervention effects, no significant changes were found on PA (days/week) or fruit consumption. Adolescents from intervention schools showed a significant increased vegetable consumption compared to adolescents from control schools. There was no significant difference between intervention and control schools on STEM interest measured with the question 'I would like to have a job that uses science'.

The findings of our impact and process evaluation show that 26 schools were reached of which 12 intervention and 14 control schools. Stakeholders were enthusiastic about and engaged with the project, and during the project we increased our reach on Twitter and the website.

Regarding co-creation within the SEEDS project, overall Makeathon evaluation questions highlighted positive results for both adolescents and stakeholders in all countries related to enjoyment of the event and their views being taken seriously. Participants liked to take part in the Makeathon event and their voices were being heard. It was a new experience for almost all adolescents and stakeholders and both mentioned the possibility of using this approach in various other topics.

Evaluation questions from the final questionnaires showed that most adolescents (56.4% – 91.9 %) participated in at least one of the activities from the intervention. When asking adolescents about their wish to maintain certain activities, answers were mixed. Cooking workshops, a sports day, drinking more water and leaflets about healthy lifestyle decisions were most popular and students wish to maintain those activities at school.

Finally, during the Brussels exchange, we gained input from both ambassadors and stakeholders within the school environment. Overall, they were enthusiastic about the SEEDS project, but also presented some recommendations. Mainly ambassadors mentioned that more time is needed for the co-creation and development of interventions, additionally ambassadors like to be involved in this. According to both ambassadors and their teachers, the international perspective of the SEEDS project was of great value and a motivator to engage in the project as an ambassador. It is a big opportunity for them, especially taking into account that individuals from low socioeconomic areas have limited means to go abroad. Although among others the Brussels exchange kept ambassadors motivated, motivation of other adolescents in schools should be an area of focus, as this was difficult within most countries. Teachers emphasized the importance of regularity of activities, involved school leadership and broad collaborations as a need for sustaining change in healthy lifestyle behaviour.

Overall, the SEEDS project was greatly appreciated by students, schools and stakeholders. A considerable amount of students was involved in intervention design. The interventions were successfully implemented and had a high reach among students. Moreover, the preliminary

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

interventions effects found on one of the three healthy lifestyle behaviours in a relatively short time underlines the SEEDS approach is a promising approach for further development and implementation.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 101006251

5. REFERENCES

1. Malva JO, Amado A, Rodrigues A, Mota-Pinto A, Cardoso AF, Teixeira AM, et al. The Quadruple Helix-Based Innovation Model of Reference Sites for Active and Healthy Ageing in Europe: The Ageing@Coimbra Case Study. Front Med (Lausanne). 2018;5:132.

2. Roberts C, Freeman J, Samdal O, Schnohr CW, de Looze ME, Nic Gabhainn S, et al. The Health Behaviour in School-aged Children (HBSC) study: methodological developments and current tensions. Int J Public Health. 2009;54 Suppl 2:140-50.

3. Kowalski KCC, P. R. E.; Donen, R. M. The Physical Activity Questionnairefor Older Children (PAQ-C) and Adolescents (PAQ-A) Manual. 2004.

4. Staus NLL, K.; Lamb, R.; Falk, J.; Dierking, L. Validation of a Measure of STEM Interest for Adolescents. International Journal of Science and Mathematics Education. 2020;18:279-93.

5. Archer LD, E.; DeWitt, J.; Seakins, A.; Wong, B. "Science Capital": AConceptual,Methodological, and Empirical Argument for Extending Bourdieusian Notions of Capital Beyond the Arts. Journal of Research in Science Teaching. 2015;52(7):922-48.

6. Faber MU, A.; Wiebe, E. N.; Corn, J.; Collins, T. C. Student Attitudes toward STEM: The Development of Upper Elementary School and Middle/High School Student Surveys. 120th ASEE Conference & Exposition; Atlanta: American Society for Engineering Education; 2013.